

## CLAIMS

1-14. (cancelled)

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15. (new) Method for the reconstruction of holographic images in digital holography, comprising the following steps:

- the hologram of an investigated object is detected and recorded by a detection device (9) that is constituted by an integrated array of image detection elements (9), that spatially sample the hologram with a number  $N$  of pixels along the x-axis of the hologram plane, each having length  $\Delta x$ , and a number  $M$  of pixels along the y-axis of the hologram plane, each having length  $\Delta y$ , thus obtaining a rectangular array of a number  $V_r = N_r \cdot M_r$  of values (51) proportional to light intensity values of the hologram, such a rectangular array being called a digital hologram;
  - the hologram is reconstructed (13,15,16,17,18) in the observation plane, starting from the digital hologram to obtain a reconstructed image of the investigated object in such observation plane;
- the method being characterised in that the reconstruction of the hologram comprises the following sub-steps:
- A. Adding new arbitrary values to the digital hologram, obtaining an expanded array comprised of  $V_e = N_e \cdot M_e$  elements (50, 51), where  $N_e = N_r + N'$  and  $M_e = M_r + M'$  with  $N'$ ,  $M'$  being integer numbers, each arbitrary value being equal to the same constant value (50);
  - B. Applying the discrete Fresnel Transform on the expanded array of  $V_e = N_e \cdot M_e$  values to obtain a final array of values proportional to light intensity values of the hologram, such final array being the reconstructed image of the investigated object;
- the total numbers  $N_e$ ,  $M_e$  of added arbitrary values being inversely proportional to the respective pixel sizes  $\Delta \xi$  and  $\Delta \eta$  to be obtained in the observation plane for the reconstructed image (14), according to the relationships:  $\Delta \xi = (\lambda d / N_e \Delta x)$  and  $\Delta \eta = (\lambda d / M_e \Delta y)$ , where  $\lambda$  is the wavelength of the wave beam striking the object of which the hologram is recorded, and  $d$  the distance between the detection device and the object of which the hologram is detected.

16.(new): Method according to claim 15, characterized in that said arbitrary constant values (50) are null values.

5 17.(new): Method according to claim 15, characterized in that said arbitrary constant values (50) are arranged externally to said array of  $V_r$  values (51), to obtain an extended array in which digital hologram is embedded.

10 18.(new): Method according to claim 17, characterized in that said arbitrary constant values (50) are arranged in a symmetrical way, i.e. said  $N', M'$  values are arranged symmetrically around said digital hologram.

15 19.(new): Method according to claim 17, characterized in that said arbitrary constant values (50) are arranged in a non-symmetrical way, i.e. said  $N', M'$  values are arranged non-symmetrically around said digital hologram.

20 20.(new): Method according to claim 15, characterized in that, after the second step, if each holographic image sampling interval is not equal or less than a certain threshold, the number of values  $N' \cdot M'$  (50) added to the digitized hologram array is increased and the hologram reconstruction step is carried out again.

21.(new): Method according to any claim 20, characterized in that said threshold is a function of the signal-to-noise ratio of the holographic image.

25 22.(new): Method according to claim 1 characterized in that  $N_e = (\lambda d / \Delta x^2)$ ,  $M_e = (\lambda d / \Delta y^2)$ ,  $\Delta \xi = \Delta x$ ,  $\Delta \eta = \Delta y$ .

30 23.(new): Method according to claim 1, characterized in that the method is performed for more than one holographic images detected at the same time for different wavelength  $\lambda$ , said more than one images being subsequently superposed in order to obtain a multi-colour final holographic image (14).

35 24.(new): Computer program characterized in that it comprises code means apt to execute, when running on a computer, the method according to claim 1.

25.(new) Memory medium, readable by a computer, storing a program, characterised in that the program is the computer program according to claim 9.

26.(new) Apparatus for detection of holographic images, comprising an integrated array of image detection devices (9) and a digitized hologram processing unit, characterised in that the processing unit processes the data detected by said a  
5 detection device (9) by using the method according to claim 1.